



Original scientific paper

Integrating Dynamic Culture and Participatory Design in Urban Spaces for Sustainable Futures

*¹ Assoc. Prof. Dr. **Ines Sahtout Gaha** , ² Prof. Dr. **Imen Ben Youssef Zorgati** , ³ Prof. **Zoubeir Lafhaj**

¹ Department of Design, Higher Institute of Fine Arts, University of Tunis, Tunisia

² School of Design, Faculty of Planning, University of Montreal, Montreal, Canada

² Department of Science and Technologies, Lille University, France

¹ E-mail: ines.sahtout@isbat.u-tunis.tn, ² E-mail: imen.ben.youssef.zorgati@umontreal.ca, ³ E-mail: zoubeir.lafhaj@gmail.com

ARTICLE INFO:

Article History:

Received: 25 March 2024

Revised: 18 June 2024

Accepted: 25 June 2024

Available online: 30 June 2024

Keywords:

Participatory Design,
Sustainable City,
Dynamic Culture,
Usability,
Parametric Mapping,
Heritage Utilization.

ABSTRACT



This study explores the intersection of dynamic culture and participatory design in urban spaces, emphasizing the role of user experiences in shaping urban environments. By integrating residents' input in the design and planning processes, this research aims to foster sustainable, viable urban futures that reflect local cultural dynamics and community needs. Utilizing a case study in Tataouine, Tunisia, the research employs parametric mapping and user experience mapping to analyze interactions with heritage sites and public spaces. This approach captures qualitative data on user experiences and overlays it with spatial context, enabling the identification of patterns and relationships between cultural practices and territorial dynamics. The study aims to identify key factors for citizen participation, analyze user experiences in relation to cultural dynamics, and formulate recommendations for integrating participatory design principles. By aligning urban development with a dynamic culture and user-centric design, the study envisions urban spaces that are inclusive, sustainable, and reflective of local identities. The findings underscore the potential of participatory design to enhance the value of urban heritage and promote a more engaged and resilient urban community.

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Publisher's Note:

Journal of Contemporary Urban Affairs stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.

JOURNAL OF CONTEMPORARY URBAN AFFAIRS (2024), 8(1), 212-231.

<https://doi.org/10.25034/ijcua.2024.v8n1-12>

www.ijcua.com

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Highlights:

- Parametric models can effectively map user paths in Tataouine, providing detailed spatial analyses of urban interactions.
- Innovative analytical tools can enhance the re-evaluation of architectural heritage, contributing to cultural preservation and urban renewal.
- Participatory design is a critical component of architectural and urban planning processes, promoting inclusivity and sustainability.
- Engaging stakeholders early in the planning process leads to the creation of cities that are organic, adaptable, and reflective of community needs.
- Integrating dynamic culture with urban development can enrich the literature on cultural dynamics and algorithmic urbanism.

Contribution to the field statement:

This article introduces a novel framework that combines cultural dynamics with participatory design, specifically applied to urban settings like Tataouine. By utilizing parametric modeling and user experience mapping, it pioneers new analytical tools for architectural heritage revaluation, offering scalable methodologies to redefine cities as algorithmic entities that adapt organically through community involvement.

*Ines Sahtout Gaha:

Department of Design, Higher Institute of Fine Arts, University of Tunis, Tunisia

Email address: ines.sahtout@isbat.u-tunis.tn

How to cite this article:

Sahtout Gaha, I., Ben Youssef Zorgati, I., & Lafhaj, Z. (2024). Integrating Dynamic Culture and Participatory Design in Urban Spaces for Sustainable Futures. *Journal of Contemporary Urban Affairs*, 8(1), 212-231. <https://doi.org/10.25034/ijcua.2024.v8n1-12>

1. Introduction

As a prelude for our investigation, let us take up Robert Fishman's inquiry, who proposed a fictitious story for defining and proposing new alternatives for building the cities of the future: What is the ideal city for the twentieth century, the one that would best express the study and beauty of modern technology and the most advanced ideals of social justice? (Fishman, 1982). The answer to this question was based on analyses of the work of urban planners such as Ebenezer Howard, Frank Lloyd Wright, and Corbusier, who produced detailed plans for factories, office buildings, schools, parks, and transportation systems; each plan introduced an innovation, and all the study are part of a revolutionary restructuring of urban form. The economic and political organization of the city, which was not easy to translate into drawings, was analyzed in the voluminous writings that each author attached to his projects (Fishman, 1982). Based on this perception, the study intends to develop an approach that resizes the configuration of today's city around new concepts such as participatory design, cultural dynamics, and parametric modelling. As the world becomes more urbanized and the human experience in urban environments becomes more diverse, the study is increasingly concerned about how the study creates, uses, and interacts in the built environment. In this context, cultural dynamics and participatory design have emerged as key concepts for understanding and embedding the city in a sustainable context, promoting the identification of uses and encouraging mutual appreciation. In this regard, there is an urgent need for governments to introduce and enforce processes that allow citizens, including vulnerable communities, to participate in development planning and policymaking. At present, there is a lack of guidance for practitioners regarding the definition of a clear purpose of community engagement and the selection of appropriate participatory methods to fulfil the set purpose (Devindi, Fernando, & Keraminiyage, 2021).

Participatory design involves the active collaboration of citizens, designers, and decision-makers in the creation and transformation of urban space. It transcends traditional design approaches by recognizing that end-users are in the best position to express their needs, preferences, and aspirations. The term participation is widely used to describe any practice or experience that involves citizens, but in most cases, neither the manner nor the degree of participation, nor the status of the people and the role given to them is defined (Croce, 2018). This democratic approach fosters greater ownership of public spaces and greater user satisfaction. Contemporary urban production and management is no longer just a matter for politicians and professionals in the field (decision-makers, architects and urban planners, construction companies, etc.). Nor is it just a matter of building buildings and roads. In the face of current social and urban changes and challenges (the need for more participatory democracy, the avoidance of urban sprawl, etc.), new "urban design cultures" are emerging, experimenting and, in some cases, ritualizing ways of saying, doing and experiencing today's city (Smail, 2021). At the same time, cultural dynamics play an essential role in the way the study perceives and interacts with our environment. Cultural values, social practices, and traditions shape our daily experience of the city.

The relationship between the study of regional culture and the city should have been a natural and smooth one of development or extinction, but rapid urbanization has upset the original equilibrium, thus restricting to a certain extent the development of a comfortable and personalized urban life (Sahari, Li, & Faridah, 2022).

By integrating these elements into the design process, the study can create spaces that reflect local identity, encourage diversity, and foster a sense of belonging. In practice, public participation is the key to the democratic process. This makes government institutions accountable to society, enables them to incorporate non-professional knowledge into decision-making, improves public policy support, and improves planning outcomes. Participation is valuable as a political goal, as it increases social capital and gives citizens more opportunities when they want a stronger voice in decision-making. (Jankauskaite, L, & Mlinkauskienė, 2021). In this paper, the study dives deep into the concepts of participatory design and cultural dynamics in the urban context. The study will present an approach to cartography based on urban and social

parameters. The cartography that is deployed as a result of our research will be integrated to redefine the context of the user experience in urban spaces. The study will also explore the challenges and opportunities that are associated with this approach, as the implications for sustainable urban planning.

This study will conduct a structured analysis of the literature and factual data based on concrete mapping and modelling to study the following questions:

- 1- What are the participatory methods that exist and are being used for community engagement?
- 2- In terms of real cultural dynamics, what level of engagement can parametric mapping methods achieve?
- 3- Are the proposed methods sufficient to support the engagement of the community throughout the urban design cycle, with a focus on a heritage specific to the city of Tataouine and with an emphasis on sustainability and resilience?

For the methodological needs of our research, the study has chosen a research project that explores the theory and epistemological needs to give us results in practice: a modelization visualized through a cartographic demonstration based on citizens' activities in the southern Tunisian city of Tataouine. Meanwhile, to better explain the goals of our research, other methods will be explored and analyzed as our research diagram evolves. In this sense, Figure 1 represents the process of our contribution and defines the specificity of our analysis.

2. Material and Methods

The aim of the systematic analysis of the user experience in the literature on the urban development of the city of Tataouine according to the location of its historical sites was to map and evaluate uses and interactions, and thus provide concrete answers to the research questions based on existing knowledge. Accordingly, the question of the study has been formulated as the study has previously specified and has been illustrated as follows: What existing participatory methods are used to engage communities, and how might Parametric Use Mapping be used to help envision a desirable architectural future?

The study proposes five distinct and complementary approaches in the diagram shown in Figure 1, which illustrates our research process. First, the study focuses on the identification of the foundations of cultural dynamics. This step is crucial to understanding the cultural foundations and the influences that shape the social interactions and behaviours in the city of Tataouine.

The study will then look at aspects of participatory design and its various forms and elements and the study will identify that Participation is often associated with the concept of democracy and it has a multidisciplinary, inclusive nature (Turken & Eyuboglu, 2021). Using parametric modelling, the study aims to create a new cartography of Tataouine that reflects the contributions and perspectives of its inhabitants, and which is defined as the dialogue between the study of a human and map, mediated through a computing device and is essential to the research into interactive cartography, visualization, and visual analytics (Roth, 2013). This participatory approach is essential to ensure that the cartography will be representative and inclusive. Third, the study presents examples of mapping methods, focusing on their conceptual and constructive aspects. These examples serve to illustrate how different techniques can be used to capture and represent urban complexity in innovative and effective ways. In the fourth section, the study presents the specifics of a cartographic case study carried out using parametric modelling. This process is a demonstration of the level of involvement of users with their immediate environment. An interpretation, adapted to the active data and the parametric parameters of the objects, will be developed to read these mapped paths. The presentation of the maps will also help us to revisit Tataouine's capacity for the reintegration of its historical sites in accordance with their uses. By analyzing the map through the activities of residents, the modelling process will be focused on concrete outcomes. These results will measure the level of involvement and interaction of users with their city and historic sites. They will identify the city's heritage and shared identity.

Finally, our conclusion offers a forward-looking perspective on urban development. The study postulates that the sustainability of architectural projects can be significantly enhanced through the interpretation and use of land-use mapping. By adopting a sustainable approach that considers the forming industry and sphere of activity for the territory (Vikhoreva, Malanina, & Ogloblin, 2020), the study aims to promote projects that respect and enhance local cultural and heritage dynamics. This approach not only preserves cultural heritage but also promotes harmonious interaction between studying residents and their urban environment. Furthermore, cartography and new technologies such as parametric design can be used to reinvent the city, reconstruct its urban fabric, and enhance its heritage.

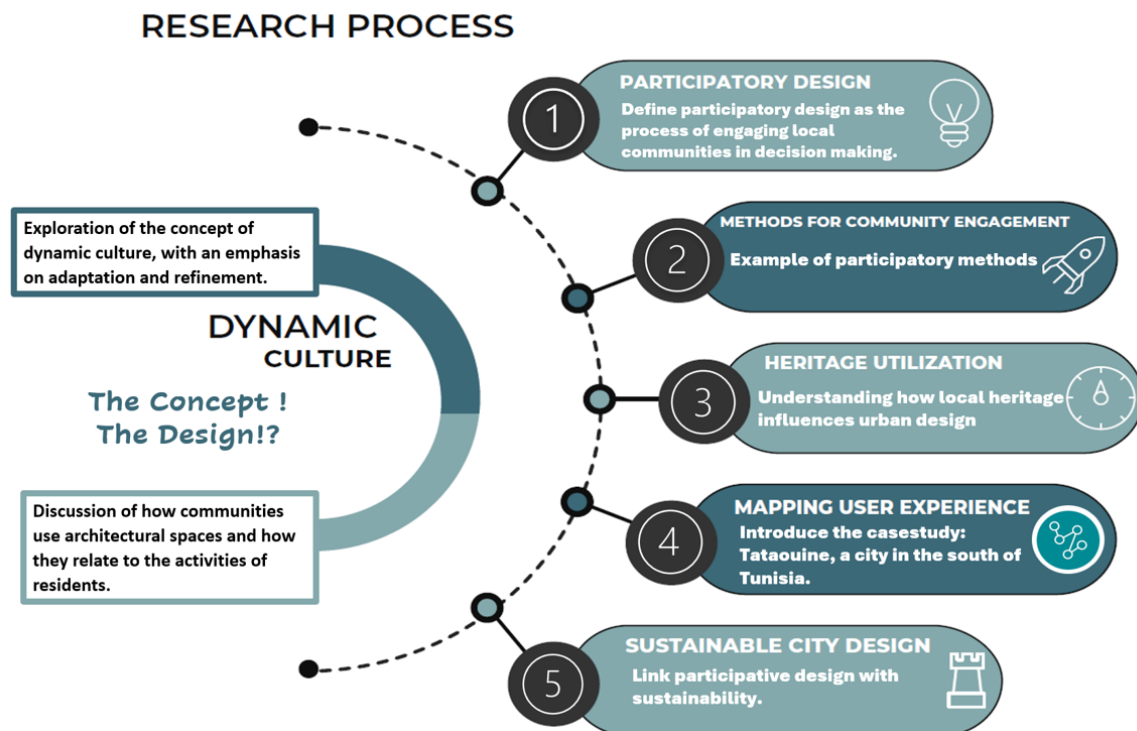


Figure 1. Research Process and Structure of the Study (Developed by Authors).

3. Theoretical Background: The fundamentals of participatory design

The approach advocated for applying our theoretical background is divided into three different interpretations. The first interpretation consists of a fundamental analysis that aims to identify the notions founded by design as a creative activity (Berger, 2004) in modelling solutions and alternatives for rereading a specific cultural heritage by and through user experience. This interpretation defines the theoretical foundations of cultural dynamics and demonstrates their relevance to participatory design. One of the techniques that has been used as a tool for urban development in recent years is that of cultural regeneration. This is seen as a means of restoring and improving the quality of urban life through the enhancement and development of the unique characteristics of a place and its people. (Wansborough & Mageean, 2000). To illustrate these foundations, an example of a pre-existing study will be presented. It will illustrate aspects of cultural dynamics and the participatory approach. Secondly, the mapping methods, tools, and resources that have been used so far for the improvement of the user experience through a spatial experience and a shaped urbanity are examined. The theoretical framework the study aims to establish in this section will serve as the foundation for our modelling and case study. It allows us to anticipate not only the impacts of urban concentration but also those of detachment. Our goal is to redefine cultural dynamics, considering novel public policy solutions and alternative approaches to

democratizing heritage sites. Additionally, the study will explore ways to establish stronger connections by better studying cultural practices, rituals, and consumer behaviours.

3.1. Cultural Dynamics' Participatory Design and Social Integration Characteristics

Dynamic culture refers to the constantly evolving, vibrant, and diverse fabric of human interactions, practices, and rituals within a city. It encompasses the ebb and flow of daily life, the varied rhythms of activity, and the collective experiences that shape urban spaces. To delve deeper, let's explore how dynamic culture intersects with participatory design, inspired by the words of J. Montgomery: Good cities tend to be a balance of a reasonably ordered and legible city form, and places of many and varied comings and goings, meetings and transactions. What might appear to some as disorder is very often simply the everyday rhythm of city life. In the absence of such activity, cities can lose their urbanity and eventually become suburban in character (Montgomery, 1998).

The study customizes Montgomery's vision in three fundamental ways:

- Urban Rhythms and Vibrancy
- Participatory Design as an Enabler
- Urbanity and Suburbanization

Table 1 illustrates the close relationship between the study's dynamic culture and participatory design. Both approaches celebrate the messy convergence of urban life, emphasizing the spontaneity of travel, unexpected encounters, and the dance of daily routines. When the study analyzes this dynamism, our cities thrive, bridging the gap between

the study disorder and vitality. Participatory design plays an essential role in this urban dynamic, cutting across cultural and local development to create a more vibrant pattern of place. It is above all a territorial design that unifies this idea of the adaptability of the city. The phenomenon of planning involving citizen's participation in planning literature has existed since the second half of the 20th century. Indeed, different methods and techniques have been used in the process. The study and participatory practices are time-consuming, and negotiations are tiresome. (Turken & Eyuboglu, 2021).

Territorial design is close to urban design, especially in its emphasis on the experience of the resident or user. There are two differences: The first is a difference in scale: urban design is localized (to the scale of the public square or the neighbourhood), whereas territorial design is part of a larger scale (which can include the neighbourhood, but also above all the city, the intercommunal area, even the region - all four can be considered simultaneously). (Jolivet, Safin, & Huron, 2021).

Table 1: Urban Dynamics: Unveiling the Heartbeat of Cities.

Urban Rhythms and Vibrancy	Participatory Design as an Enabler	Urbanity and Suburbanization
Cities thrive on: <i>movement+ diversity+ interaction</i> The comings and goings of people: Bustling through markets+ gathering in public squares+ engaging in spontaneous conversations = <i>Creation of the heartbeat of urban life</i>	Cities are not static entities but living organisms shaped by their inhabitants: <i>Stakeholders + residents, architects + planners + community members + Designers</i> = collaboration to shape urban spaces Knowledge experiences+ aspirations = <i>Inform the design process</i>	What makes a city truly urban Urbanity = <i>Vibrance+ complexity+ adaptability</i> It thrives on the interplay of people, activities, and cultural expressions.
What might initially appear as: <i>disorder+ crowded streets+ impromptu street performances+ lively cafes</i> = Dynamic culture	By involving End-users, Participatory design ensures that: <i>Resulting spaces + city's unique cultural context</i> = Empothe studies people to actively influence decisions Fostering a sense of ownership and pride	Cities lose their dynamic culture when: <i>streets become sterile+ public spaces lack vitality+ interactions wane</i> = <i>Risk of slipping into suburban character</i> Codesign revitalizes urbanity by infusing spaces with creativity inclusivity+ responsiveness to local needs.
Richness and Authenticity of Urban Experiences.	Participatory Design aligns with Dynamic Culture.	Participatory design acts as a counterbalance.
Empowering Communities: Participatory Design in Action		

3.2. Methods for Community Engagement

3.2.1. User experience-centered Approach Method

Using an experience-centered approach and mapping user journeys, the user is able to understand the importance of wayfinding and community collaboration for the "Entre les Ksour" project simulated by (Nesrine, 2019) in her study of the city of Tataouine. This simulation proposed public transportation solutions that would allow citizens and visitors to easily move between historic sites, providing a unique heritage experience and a greater appropriation of the urban environment. Exploring roads: These can be streets, pedestrian roads, public transport areas, canals, and railways. These elements are dominant in the image of many people. People observe the city on the move and perceive other environmental elements on these roads and relate to the whole. (Yavuz, Ataoğlu, & Acar, 2020).

This simulation aimed to improve the accessibility of the Ksour. It also actively involved the community. It adopts a pragmatic approach whose principles value experience, participatory processes of codesign, and project-grounded research.

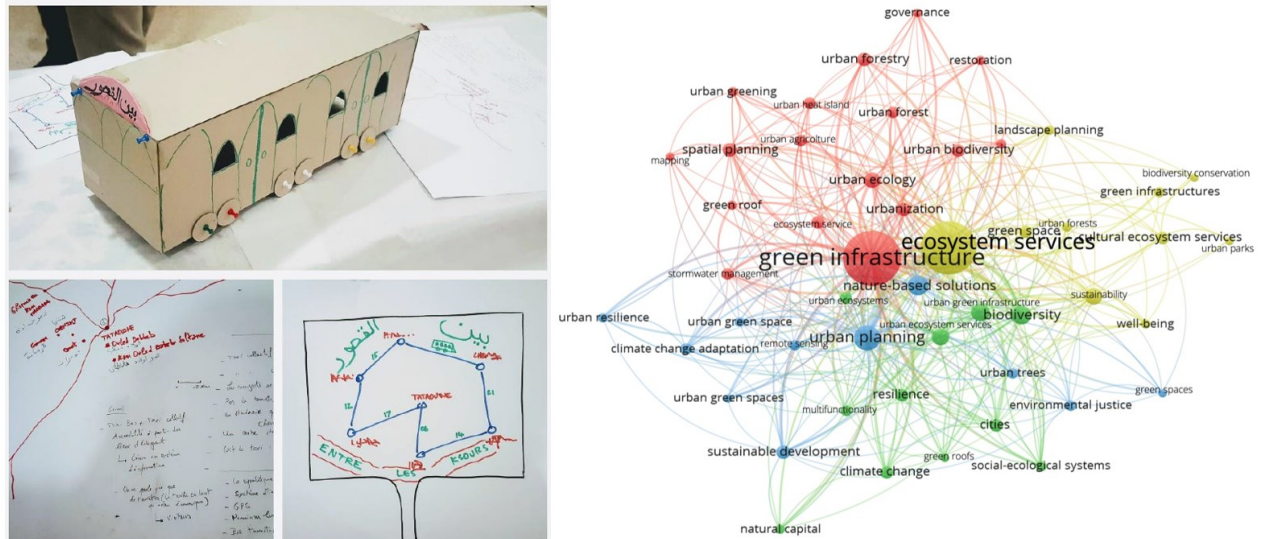


Figure 2. Project proposal of Between the Ksour (Ellouze, 2019).

Urban Mapping Tools & Techniques (URBAN DESIGN LAB)

To instantiate our co-design model, the initial idea and motivation came from a public integrator (Tataouine Governorate) who possessed an untapped resource (the Ksour) and wished to develop new services to strengthen regional attractiveness and promote local actors. As shown in Figure 2, the vision of the project was therefore to capitalize on the links established between institutions and to encourage cooperation and exchanges between professors and experts from different disciplines. (Ellouze, Ramseyer, & Brisolar, 2021). The first idea is to bring conceptual features, as you can see through Figure 2, where a cluster of words and colours highlights urban planning and uses in terms of a specific vocabulary and convergent, interdisciplinary relationships. The second is a human-experienced concept delivered through between the ksour as a research project. Based on observing the lack of public transportation, signage, and difficulty of accessing without a guide, the simulation proposed tangible ways for citizens to connect with their cultural and natural heritage. By considering the lived experience of users and their uses, this approach proved viable and worthy of integration into the city's urban planning.

3.2.2. Design by and through citizen activities

To demonstrate that participatory design and cultural dynamics are two complementary and mutually stimulating concepts the study refers to the two methods developed by Ezio Manzini (2014) for Social dynamic Innovation.

Designing for the community: This design means looking at specific typologies of collaborative service and, after observing their strengths and the study weaknesses, intervening in the context of the services to make them more favourable, and developing solutions to increase their accessibility and effectiveness and therefore their replication. In this mode, designers have to conceptualize and develop solutions for specific collaborative services and other enabling artefacts (e.g., digital platforms, orienting scenarios, and catalyzing events, including exhibitions, festivals, and other cultural events) (Ezio, 2014).

Designing with the community: This means participating as peers with other actors involved in creative community building and collaborative service co-design. In this modality, designers must facilitate the convergence of different partners toward shared ideas and potential solutions. This kind of activity requires a set of new design skills: promoting collaboration among diverse social actors (local communities and companies, institutions, and research centres); participating in the construction of shared visions and scenarios; and

combining existing products and services to support the creative community members with whom they collaborate (Ezio, 2014). The study intends to go further than these two forms of participatory interpretation and develop a new approach Figure 3 based on designing through and by the interpretation of users' activities and real-life experiences.

- Cultural dynamics are shaped by the visibility of lived experience and represent the interaction between the study of a participative approach and the design of public policies.
- Cultural dynamics thus become a key element in making users aware of the heritage value of their sites and/or their region.

Innovation would be the organization of the city around all these elements that coordinate life and animate and co-animate urban development. Furthermore, it is possible to create solutions that meet users' real needs by involving the community in the design process. It can also foster a sense of pride and a sense of belonging to the cultural and natural heritage of the city. Cultural dynamics and community involvement are therefore key elements in architectural heritage conservation. By drawing on the experience and cooperation of residents, the study can enhance and preserve historic sites and monuments for future generations, while strengthening the social fabric and understanding of local history and culture. Liang, W., Ahmad, Y., & Mohidin, H. H. B. (2023), mentioned through their analysis demonstrating the correlation between user awareness and heritage enhancement of a community prescient that The conservation of architectural heritage in urban spaces is not only about preserving the historical buildings of the past but also about uniting stakeholder groups, identifying architectural heritage, gaining a collective cultural identity, finding a sense of place and civic pride for residents, allowing everyone to appreciate the cultural values of the city today, and creating a cultural identity for future urban planning through this process (Cauchi Santoro, 2016). As the study explores the convergence of dynamic culture and participatory design in the urban context, cartographic tools and mapping techniques emerge as powerful interpretive methods. They allow us to navigate and rethink the future of urban spaces. Here's how these tools and techniques can be defined according to our research study concept:

Modelling journeys

- Cartography transcends language and cultural barriers. It becomes a visual language shared by residents, planners, and decision-makers. As the study presents modelling 2 in Table 2 with a specific brainstorming technique in Figure 2 the study focuses our research on parametric visualization of user paths.
- The study can use maps to tell the story of how a city evolved, to reveal its dynamics, and to show how people interact with the environment in which they live.
- Route and wayfinding simulations help us anticipate user movements. They are essential for designing user-friendly routes and maintaining accessibility.
- By integrating historical and cultural data, these models can guide visitors to heritage sites while promoting an evocative experience.

Participatory mapping

- It is essential to involve the local community in the interpretation of the mapping of their city. Residents know the hidden places, the informal paths, and the daily anecdotes that are the foundation of their sense of place.

Utility Mapping

- Beyond streets and buildings, usage mapping explores how people interact with space. Where do they congregate? What are their habits?
- By identifying pedestrian flows, meeting places, and underutilized spaces, the study can design urban interventions that are more relevant and tailored to the real needs of residents: the study engaged a mapping in the field of participatory design creating

value for urban societies. The study wanted to look at theories and models that have the capability to generate measurable impact on urban challenges and stimulate sustainable urban transformation. (Von, T, S Verhagen, S, & Loorbach, 2019).

3.3. Heritage Utilization for a Designed Dynamic Culture

Notice that by exploring the traditions, know-how, lifestyles, and habits of a community, it is possible to discover other architectural and urban interpretations through daily activities and uses. Through the schematization Figure 3, the study explores the hidden meanings that use can have; Manzini discovered that social design is done with or for the community, but to evoke and integrate citizen practices, the study emphasizes and engages in a cartographic process to promote design through activities.

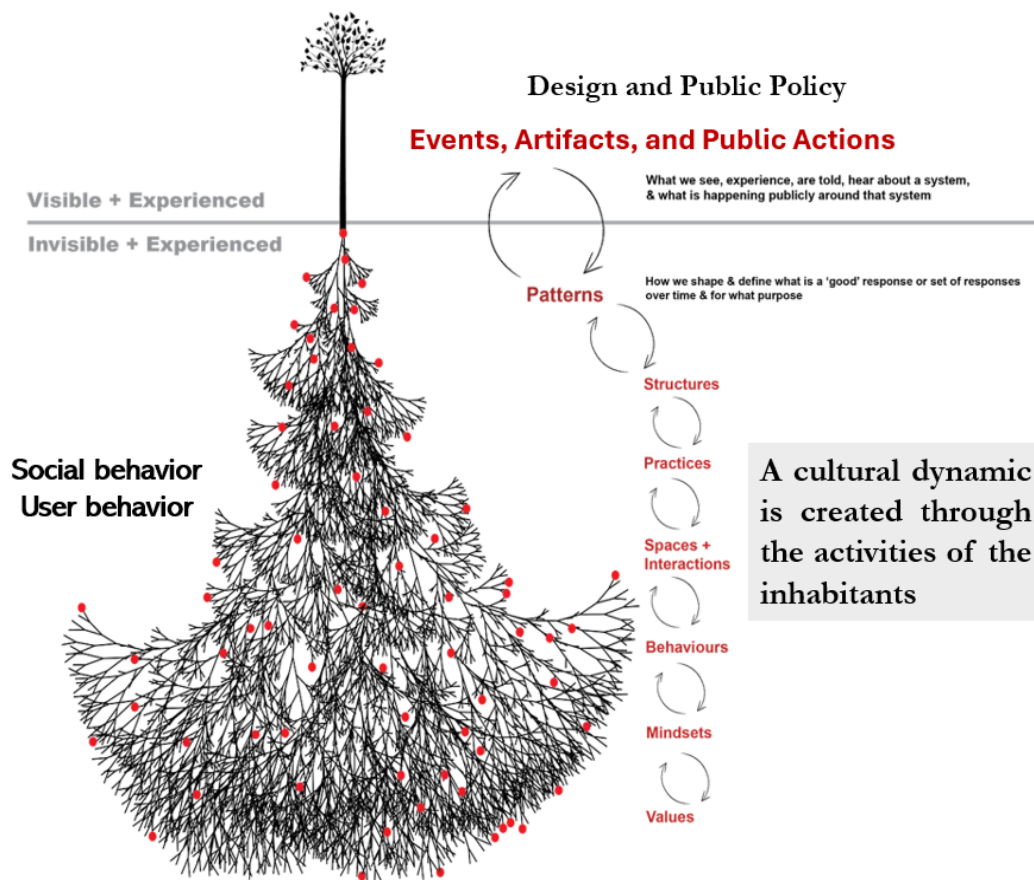


Figure 3. Changed by Authors, Inspired by the organic patterns of systems.

Analyzing Urban Activities and Experiences: Movement mapping

In our cities, every interaction and movement creates data that reflects how the study lives and uses our urban spaces. By analyzing this data, the study can uncover patterns in how spaces are utilized and understand the relationship better between people's behaviours and the environment. This analysis is crucial for designing urban spaces that are tailored to the specific needs of the community.

- Cities generate a vast amount of data from participatory activities and experiences that can be analyzed to provide information about spatial experiences and dynamic behaviours Figure 3.
- This can include information about how people move, what they do, and how they use spaces.

- This data can be useful for understanding patterns of place use and the relationship between citizens/habits/behaviours and the environment. Modelling 2, Table 2. It can be used for planning that is tailored to the needs of regional and specific users.

In essence, dynamic use mapping becomes a means of interpreting the city as it adapts to current needs. It invites us to explore narrow streets, lively squares, and changing spaces while keeping an eye on the future. This approach, rooted in citizen participation, allows us to rethink housing from a more social and even more economic point of view. It also allows us to rethink the enhancement of historic sites. Thus, in our second phase, the study intends to demonstrate through parametric modelling how the Ksour of Tataouine are detached from the city and its central activities. modelling that maps the relationship between users and the convergence of their experiences.

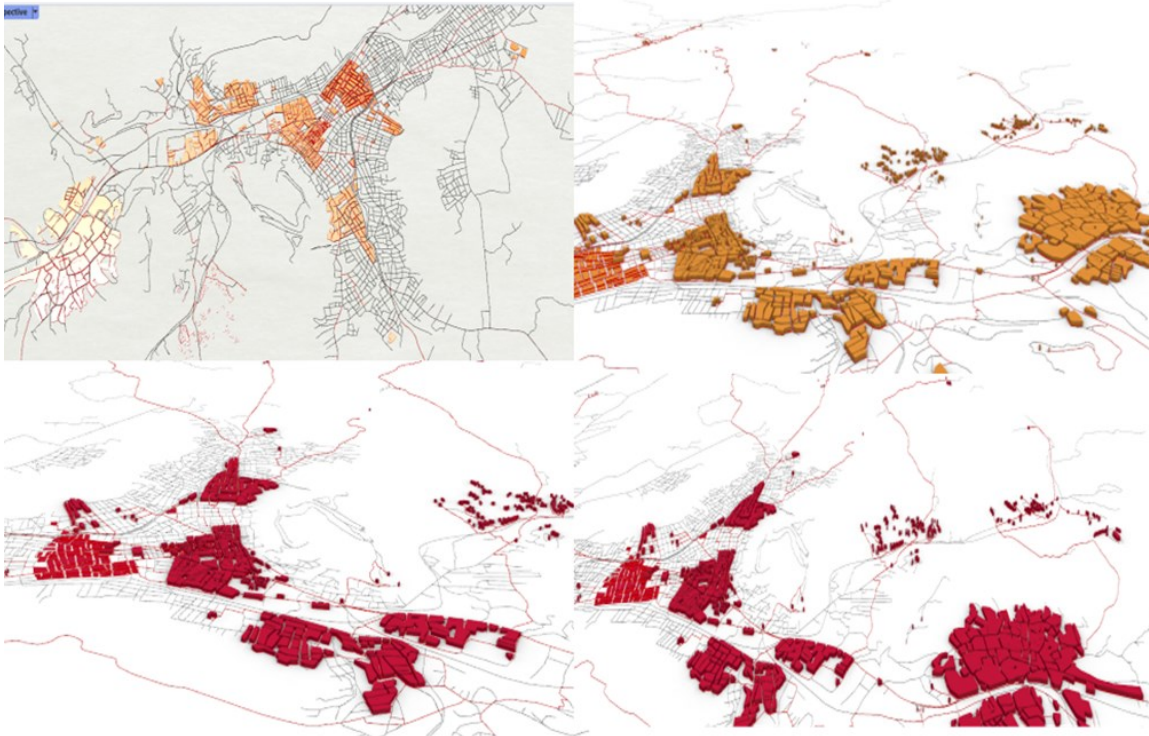
4. Mapping User Experience: Case study- TATOUINE

Second, an urban meaning that considers the tangible, social dimension of the city and, combined with the innovation of technology, configures the needs of users. The second type invites us to become part of an intelligent schematization that advocates new readings and interpretations of the complex system that is the city. Its optimization depends not only on the will of a community but above all on new reading and interpretation tools.

Bernard Stiegler (Stiegler, 2016) emphasizes the importance of inventing a new urban intelligence and confirms that the study must invent a new urban intelligence. The study needs to use digital platforms to organize local deliberations and give citizens the ability to take control of their city's technological destiny (Anne, 2017).

For this reason, the study proposes to model the activities and routes of the citizens of Tataouine for a simulation of the journeys to the ksour, to progress towards our case study. The integration of an interactive and specifically parametric component is essential for the emergence of new ideas. A contemporary urban design process demands human-centred development where future technologies intertwine with traditional approaches to generate a sustainable, liveable environment while saving time and resources (Fink & Reinhard, 2019). A map of the cultural dynamics of the city of Tataouine was created using this parametric modelling approach.

Table 2: Setting Orientation Parameters.

Modelling 1
Adding OSM (Open-Street-Map) geographic data for the city of Tataouine and setting orientation parameters
1- Import OpenStreetMap (OSM) geographic data for the city of Tataouine.
2- This data includes detailed information about the topography of the city, its streets, buildings, and other geographic features.
3- Customize and adjust parameters to orient the map according to the daily activities of residents.
4- Focus on the essential amenities for citizens.
5- Customize the map to better meet needs, functions, and uses.
Modulization Results


Participatory design is inextricably linked to urban development and the methods advocated for its implementation. Furthermore, technological advances offer new experiences in spatial exploration. The models the study intends to use to analyze our case study are combinations of parameterized objects that exhibit a form of spatio-temporal interoperability. In this way, a primary reading of the urban and topographical context of the city of Tataouine is developed, offering a static vision of places, environments, and constructions. This parametric modelling allows for an in-depth, dynamic understanding of the interactions between different urban elements while integrating the perspectives and needs of residents into the urban planning process. Exploring Tataouine virtually allows us to uncover the essential amenities that significantly impact the daily lives of its residents. This virtual journey helps us decode the city's concealed features and understand what truly matters to the local community. Table 2 outlines the procedures required to obtain a specific map of Tataouine and a justified description of its functions. Parametric design mapping enabled us to virtually penetrate the city and decipher its algorithms and organic value.

Table 3: Exploring the map with programs and algorithms.

Modelling 2	
Minimizing mass addition distances, the blue paths shown on the map below are modelled.	
1-	Entering the city virtually
2-	Deciphering its hidden characteristics: to discover the amenities that are particularly important in the daily life of the inhabitants of Tataouine.
Modelisation Results	
	

By minimizing the distances for mass addition, the study revealed that user activities are centered around a focal point, identified as ELECTROSAYEH, a sales area. As demonstrated through the model presented in Table 3, the study illustrates how these activities are organized according to a program that highlights the city's central point. The pathways connecting various activities at different times are mapped out by connecting lines. The study employed parametric modeling to calculate and visualize spatial movements within Tataouine, leading to the identification of ELECTROSAYEH as the barycenter. This point is recognized as the core of the city's dynamics, providing unique insights into the urban structure and the daily flow of its inhabitants' activities.

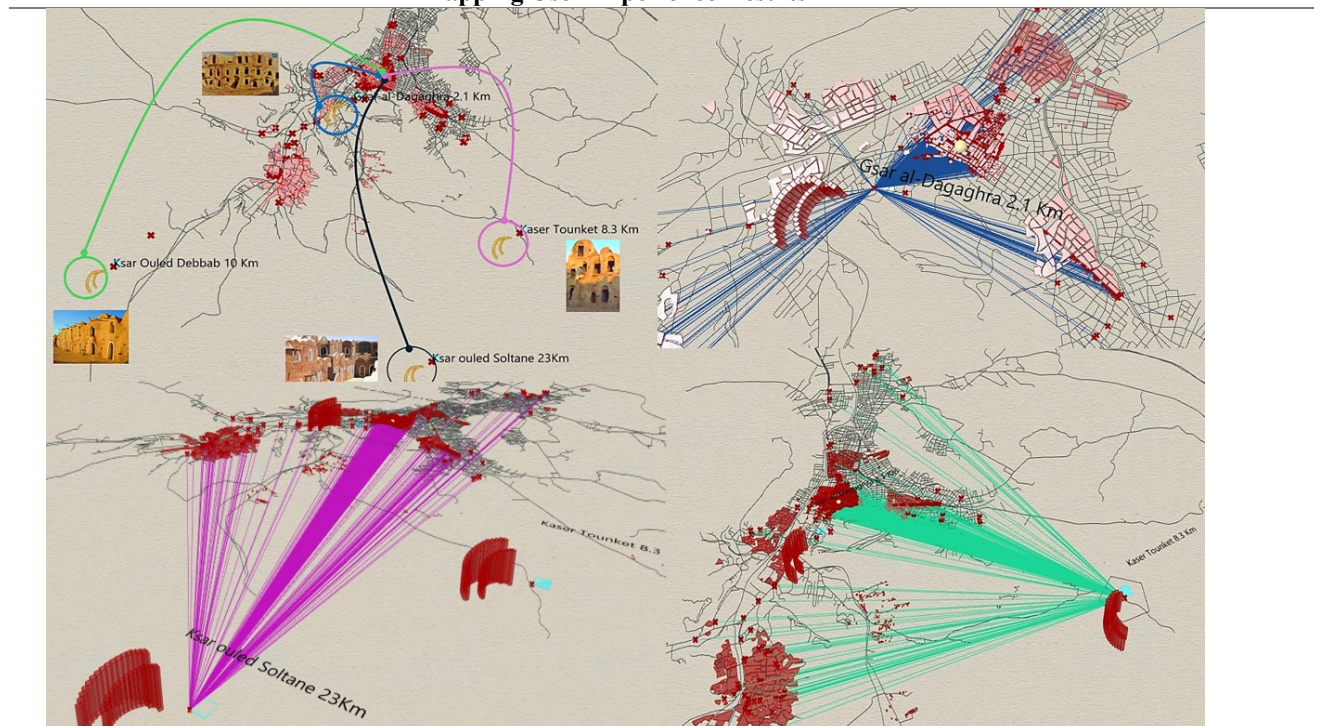
To further illustrate this, the activities modeled in Table 3 are linked to the functional diagram of the ksour. The study simulated the placement of the ksour in Tataouine by accurately managing the real distances between them and the city, particularly their relationship to the ELECTROSAYEH barycenter. This modeling, as shown in Table 4, enables a deeper understanding of the city's layout based on both common and uncommon patterns of use. The value of the ksour is enhanced by synchronizing user activities according to their locations (maximizing distances) and by creating a network of routes distinguished by different colors and connections between the sites themselves.

The study will now present the cartographic results, displaying user routes by minimizing and maximizing the distances between the Tataouine barycenter and various ksour, providing estimates of visit frequencies.

Table 4: Mapping the detailed user experience.

Modelling 3
Minimizing and maximizing mass addition distances, the coloured paths shown on the map below illustrate the location of the ksour and their relationship to the center of Tataouine.
1- Ksour Locations: Ksar Dghaghra, Ksar Ouled Debbab, Ksar Ouled Soltane, and Ksar Tounket
2- Calculate the distance of arrival and departure
3- Calculate route values
4- Walk the map, Discover the Ksour, and Color the routes.

Mapping User Experience Results



Urban designers draw inspiration from a variety of principles to create sustainable, user-centred spaces in harmony with community lifestyles. One of these guiding principles could be the new cartographies that have emerged as an alternative with the birth of Generative Design. This new cartographic experiment emphasizes citizen participation, seeing through the social understandings of individuals to relational bases that evoke meaning. In the context of our project, the installation of ksour as a functional unit within the central activity of ELECTROSAYEH in Tataouine Table 2 is a fascinating exploration. By modelling activities and travel distances, the user is able to optimize routes to key ksour, including Ksar Dghaghra, Ksar Ouled Debbab, Ksar Ouled Soltane, and Ksar Tounket Table 4. This approach is consistent with a new mapping goal of creating vibrant, well-connected communities.

5. Findings and Discussion: The rhythm city, the algorithmic city

The theoretical fundamentals of this research project were developed by identifying ancient cartographic methods such as the "between the ksour" exploration developed by Nesrine Elllouze (Nesrine, 2019). It focuses on the fundamental aspects of participatory design and cultural dynamics. As for our case study, which took place in Tataouine, the study tried to

model the city according to its uses, to penetrate it and bring out the degrees to which its citizens belong. In this way, the study understood that the population is a good variable to measure the importance and the success of a city, that the city is a whole system, and that the study can identify the science of the city. This is the controversial issue the study has tried to address in this study by approaching Tataouine's activities as a function of its historical sites and its dominant interurban displacements. In this way, and according to our modelling, the study has come to understand that the design of a city is determined by external interventions and urban problems are complex issues whereby social, economic, and environmental dimensions are intertwined. (Pertoldi, Fioretti, Busti, & Van Heerden, 2020). The city is not a fixed design, which is positive for territorial planning. A model is an abstract and partial representation of some aspect or aspects of the world "that can be manipulated to analyze the past, define the present, and consider possibilities for the future (Couclelis, 2002). Thus, mapped models of cities, which show the use of citizens as an essential component, also allow us to decode the city and read its components, focusing on its strengths and weaknesses to write an impressive future.

To analyze and discuss the results of our modelling and our approach, the study will base our analysis on the question the study posed in the introduction of our article, which is formulated in the following way: Are the proposed methods sufficient to support the engagement of the community throughout the urban design cycle, with a focus on a heritage specific to the city of Tataouine and with an emphasis on sustainability and resilience?

Mapping experiences through urban development is a complex field that translates actions into our cities. To answer our question, the study will look at two emerging approaches: The "Rhythm City" and the "Algorithmic City", which are mapped via uses and calculated via parameters. The study will explore these two concepts and their implications for the design of sustainable, user-centered cities. Therefore, to propose possible future solutions, the study breaks down our modelling results according to these two readings.

▪ **The Rhythm City**

As configured in Figure 4 the rhythm city is inspired by the rhythms of travel, way findings, and movement Table 1. It is a view of the city as a dynamic composition in which human activities create rhythms and harmonies. The city of Tataouine, as revealed by user journeys in parametric modelling, does not connect its historic sites through activities. Although their territorial presence differs from the overall schematization of the centre, these sites reflect an enduring heritage entity. In this sense, the study proposes to design our cities and territories in a way that promotes reconciliation, regularity, and civic expression. The models presented in Table 4 show that the study is not faced with a simple problem of geometric design, but rather with a question of the geographical enhancement of places. It's about finding a balance between centralization and decentralization, between concentration and diversity. All these elements contribute to the urban design of the city. The rhythm of the city will come from the layout of the streets and the uniqueness of the places. A rhythmic city adapts to the actions of its citizens, to the climate and the paths they take, as the study of public policies. On the other hand, it is essential to involve citizens in the creation of their living spaces. Urban strategies can be seen as collective roadmaps, aimed at triggering a desired change. (Pertoldi, Fioretti, Busti, & Van Heerden, 2020). This becomes an essential value. In other words, the city of Tataouine will be described as "rhythmic" if its inhabitants truly decide to work together to revitalize their cultural and heritage identity. It's no longer a question of style and modeling, but of compositions based on use and usability.

▪ **The Algorithmic- Organic City**

The study shows that the city of Tataouine can be organized in an organic manner by utilizing data related to its usage patterns. So, before developing the concept of the algorithmic city, it would be better to know what the organic city is. To define the organic city, the study

agrees with Harpet and Pincetl (2019), who point out that the city is an organization that not only mobilizes architectural and urban planning knowledge, but above all requires knowledge of human neuro-cerebral functioning and interactions. (Harpet & Pincetl, 2019). Organic urban planning is based on the ability to make the knowledge of project managers and designers available to residents as owners. These specialists provide tailor-made solutions to specific needs, mirroring the unique persona of each inhabitant. Otherwise, we are asking the same question as Pumain (2006) who states that: could the algorithmic city be the reunification of the concept of the city-object, understood both as a particular form of land use and as differentiated clusters of buildings, activities, and population on a territory, or can it emerge from a reflection on the fractal structure of cities, taken in their materiality? (Pumain, 2006). Thus, in the context of our research, the algorithmic city is defined as an organic city that is well developed in urban terms and that takes urban data as its primary component because when data is analyzed, it provides us with highly fractalized details about lifestyles and the territorial nuances of the inhabited space:

Data Analysis: The study collects data on travel patterns, consumption habits, and social interactions. Algorithms are used to analyze this data to identify trends and opportunities for improvement.

Personalization: The "Algorithmic City" identifies urban interoperability. Itineraries are tailored to individual preferences, recommendations, and neighbourhood associations. Parametric design is the ultimate enabling technology for this focus. It allows the morpho structural and morphological possibilities of the city to be deciphered, updated and brought to life. In contemporary architectural Design, the study speaks of a parametric structural design. A design that integrates new functionalities crossed with the spatial geometry of objects. It has been considered structured because it optimizes combinations that integrate a minimum of materials and data to respond to functions, uses, and needs more adapted to a society in perpetual evolution. (Sahtout, 2023). The preservation of cultural heritage and the revitalization of territories are major issues for urban planners and decision-makers. Through this discussion, the study will explore three key aspects: knowledge of the risks of heritage loss, the role of participatory and territorial design, and the integration of technological values for the revitalization of our local spaces.

5.1. Understanding the risks of heritage loss

According to our analysis, the location of the Ksour in Tatouine is not related to the activity of the city and, as the study has shown in Table 3, Electrosayeh is the focal point of the city. The risk would then be that these sites could only be visited as a function of ephemeral events and tourist seasons. On the other hand, what the study calls an organic and algorithmic city is one that redraws its urban contours as a function of the revalorization of its heritage. Heritage loss is a global challenge. Planners need to understand the factors that threaten our heritage: rapid urbanization, conflict, neglect, and changing lifestyles.

5.2. Rethinking Redevelopment with Participatory and Territorial Design

The phenomenon of participation has been an essential component of the globally accepted sustainable city concept since the 1970s (Turken & Eyuboglu, 2021), so the study strongly believes that community involvement, as shown in Table 3 is essential to creating sustainable and resilient cities, and for this to happen, the study need to think about

- ✓ Involve the community from the start: Involve residents from the planning stage. Their local knowledge and specific needs are invaluable in designing urban spaces adapted to their reality.

- ✓ Participatory Consultations and Workshops: Organize public consultations, workshops, and information sessions. This helps to gather ideas, solve problems, and create a sense of ownership.
- ✓ Participatory mapping: Use participatory mapping tools to identify vulnerable areas, local resources, and opportunities for sustainable development. Residents can contribute to the collection of geospatial data.
- ✓ Narratives and Awareness Raising: Tell stories about sustainability and urban resilience. Stories can inspire action and mobilize the community.
- ✓ Ongoing evaluation: Engage the community throughout the design process, from planning to implementation. Ongoing evaluation ensures that projects meet changing needs.

5.3. Integrating technological values

Our survey revealed that the use of parametric modelling enables us to generate designs that are better adapted to the specific needs of users while considering environmental and economic constraints. This design approach also enables better integration of the various disciplines involved in the design process, such as architecture, engineering, and construction. (Sahtout, 2023). Digital and parametric mapping technologies offer opportunities to revitalize our territories. Parametric urban modelling can be used to reconstruct and simulate design scenarios for redevelopment experiments and assess their impact on heritage. In Figure 4, the results of the five user journeys intersect, further highlighting the disconnect between the Ksour site and the city. Table 4 also defines our first exploration of the analysis, confirming our main concern: to regenerate the city of Tataouine by highlighting its historical identity and promoting civic action. The model presented in Figure 5 traces the periphery of the city concerning the Ksour, while maintaining the relationship with the central focus of citizens' daily activities.

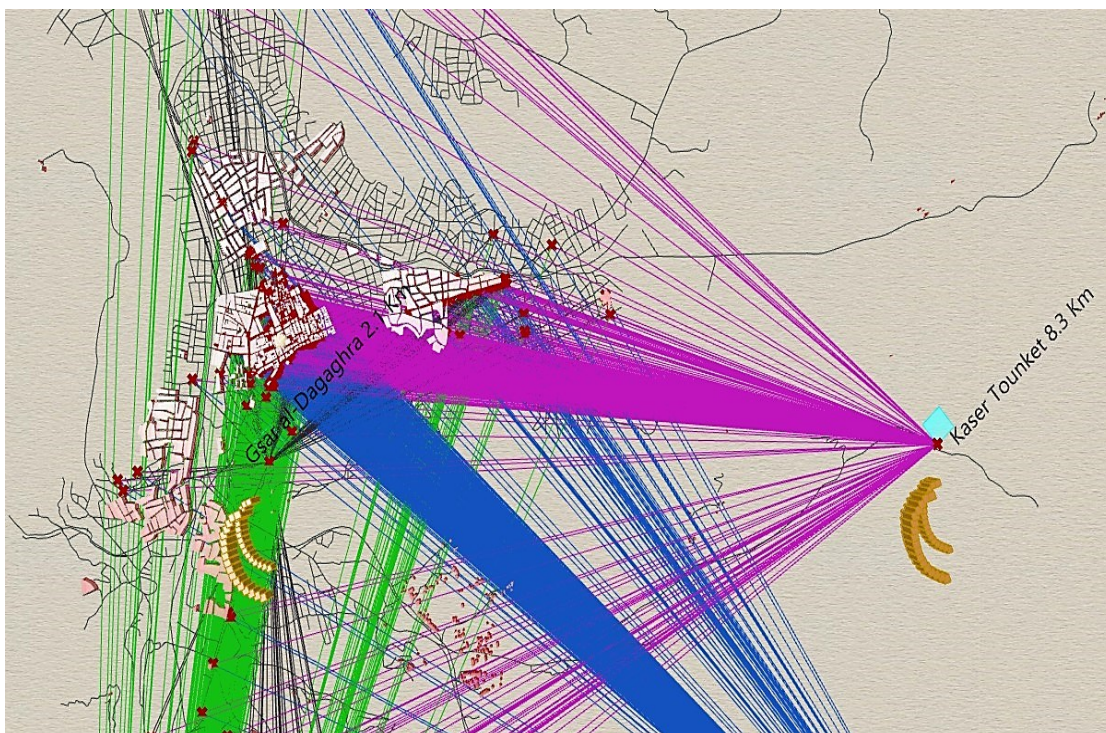


Figure 4. Result Mapping In-between the Ksour- Tataouine Ksour's.

5. Conclusions and Future Research Directions

In conclusion, this study presents a personalized framework inspired by Tim Brown's concepts (Lina, 2015). As shown in Figure 5, the research proposes a trilogy that outlines the deployment of a usage map based on cultural dynamics. This framework emphasizes the resilient enhancement of cultural heritage, with a focus on sustainable preservation and the maintenance of its legacy. Developed through a participatory methodology, it calls for the inclusion of case studies that capture the evolving nature of user experiences, regional distinctions, and, crucially, sustainable urban development. This approach aims to ensure that cultural heritage remains vibrant and sustainably integrated into urban environments, promoting a resilient, user-centered future.

The concept of livability introduces a practical perspective to the broader philosophical goals of sustainability. While sustainability tends to focus on long-term objectives, livability addresses immediate, tangible conditions and interventions, making it appear more achievable (Ruth & Franklin, 2014). Understanding how livability aligns with sustainability can help urban planners reconcile the present-day needs and preferences of residents with the longer-term goals of sustainable development (Farzaneh, 2017).

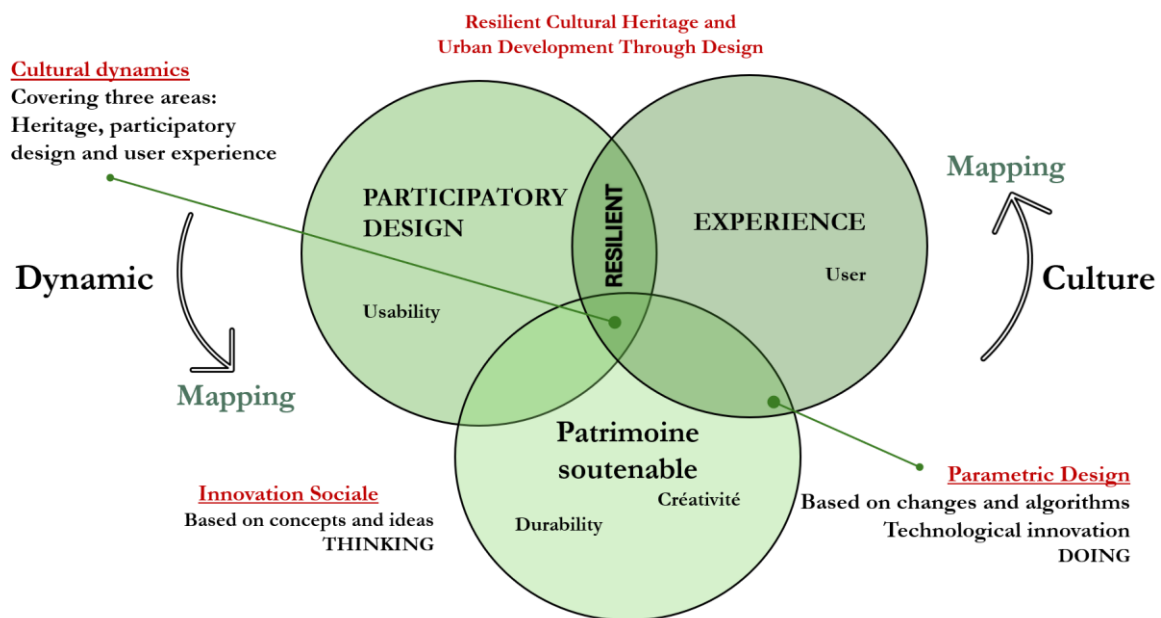


Figure 5. Mapping User Experience: The Dynamic Cultural Process.

More specifically than these examples of sublimating cartography, new models can be designed to answer the complex questions raised by the development of urban dynamics in cities, and above all to enhance the value of a heritage as unique as that of the city of Tataouine. To resemble participatory experiences and paths, a "parametric" solution would be to combine algorithms specific to shared living spaces, circulation and moldability of uses, and experiences to be commissioned and composed in city centres. Several methods will be innovated in a participatory and transdisciplinary way. Although institutional actors admit the existence of a generalized urban crisis because of real estate speculation and deregulated urban development, they also advocate that it can be treated as a temporary crisis that shall be resolved through targeted technical and policy measures that fall under the umbrella of sustainable urban development. However, the complexity of contemporary territories requires an approach that can address the numerous economic, ecological, technological, and cultural links between urban development and sustainable planning. (Antonios, 2020). Codesign and parametric design can provide new technical and

technological solutions to these crucial issues of urban development and participatory living. Cartography is only a medium that can facilitate the dialogue between stakeholders in an alternative of co-construction, sustainability, and longevity. Working on the issue of the smart city operatively involves systemic approaches to transformation, and the challenge would be to find a way to link technology to use through design. There is no such thing as a model smart city. But there are different uses to be observed, and complex realities to be discovered, there is a growing movement towards viewing cities and regions as complex and sociotechnical with people and communities interacting with one another and with objects, such as roads, buildings, transport links, etc, within a range of urban and regional settings or contexts. (Robert, 2022). In a way, design organizes the encounter of space and objects with the individual. Thanks to its interdisciplinary approach, it can be a catalyst for urbanity in this "smart city". Today, the smart city is a fiction that hasn't met the user. Urbanity is a question of friction, of understanding, of creating a common language. It is on this condition - the condition of design - that the connected city will be truly intelligent. (Orsoni, 2016). The complexity inherent in projects to create cultural dynamics, characterized by their multidisciplinary and historical nature, highlights the need for in-depth collaboration and innovative tools, including parameterized, technical, and technological dynamics. When it comes to preserving a particular heritage, there are many issues at stake. Historical, architectural, cultural, and environmental aspects interact in a complementary way, requiring a territorial innovation approach. What's more, uncertainty is often a feature of these projects, whether due to the demanding nature of the heritage elements or to budgetary and logistical constraints. By integrating new technologies, advanced modelling, parametric design, and urban mapping, this dynamic approach offers powerful solutions to the complex challenges of preserving and developing our heritage. It enables professionals from multiple disciplines - archaeologists, architects, curators, designers, and digital technology specialists - to work synergistically through design and the lived experience of users.

Acknowledgements

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflict of Interests

The Author declares that there is no conflict of interest.

Data availability statement

Data is openly available in a public repository that issues datasets with DOIs.

CRedit author statement:

Conceptualization, data curation, and formal analysis were conducted by Ines Sahtout Gaha, with additional data curation by Imen Ben Youssef Zorgati and Zoubeir Lafhaj. The methodology was developed by Ines Sahtout Gaha, Imen Ben Youssef Zorgati, and Zoubeir Lafhaj. Software utilized includes Rhino 3D, Grasshopper, and Adobe Illustrator, with contributions from Ines Sahtout Gaha and Hafedh Gaha. Writing, review, and editing were carried out by Ines Sahtout Gaha. The author has read and approved the published version of the manuscript.

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How to cite this article:

Sahtout Gaha, I., Ben Youssef Zorgati, I., & Lafhaj, Z. (2024). Integrating Dynamic Culture and Participatory Design in Urban Spaces for Sustainable Futures. *Journal of Contemporary Urban Affairs*, 8(1), 212-231. <https://doi.org/10.25034/ijcua.2024.v8n1-12>